04-ESQ-0189

U.S. Department of Energy
Office of River Protection
P.O. Box 450
Richland, Washington 99352

04-WTP-190

AUG 30 2004

Mr. J. P. Henschel, Project Director
Bechtel National, Inc.
2435 Stevens Center
Richland, Washington 99352

Dear Mr. Henschel:

CONTRACT NO. DE-AC27-01RV14136 – APPROVAL OF BECHTEL NATIONAL, INC. AUTHORIZATION BASIS AMENDMENT REQUESTS (ABAR) 24590-WTP-SE-ENS-04-013, REVISION 0, VACUUM BOX LEAK TESTING, AND 24590-WTP-SE-ENS-04-093, REVISION 0, CLOSURE WELDS

References:
1. BNI letter from J. P. Henschel to R. J. Schepens, ORP, "Transmittal for Approval: Authorization Basis Amendment Request 24590-WTP-SE-ENS-04-013, Revision 0, Revise Leak Test Requirements for ASME B31.3 Piping in SRD," CCN: 090781, dated June 3, 2004.

2. BNI letter from J. P. Henschel to R. J. Schepens, ORP, "Transmittal for Approval: Authorization Basis Amendment Request 24590-WTP-SE-ENS-04-093, Revision 0, Revise Leak Test Requirements for ASME B31.3 Piping Closure Welds in SRD," CCN: 090782, dated June 3, 2004.

This letter approves the referenced ABARs and transmits the associated Safety Evaluation Report (SER), which documents the U.S. Department of Energy, Office of River Protection evaluation of the proposed changes in the requests. Several discussions have been held with your staff resulting in clarification on the use of vacuum box leak testing and the application of closure weld criteria. Of particular concern was the piping in black cells which poses a unique situation in that no repairs or inspections are possible during the 40-year plant operating life. As a result of these discussions, these ABARs propose several new requirements on the application of vacuum box leak testing and restrictions that are to be included in the Safety Requirements Document (SRD). Also, the requested exclusion of leak testing on closure welds will not be authorized in black cells. Due to the extensive details which must be included as part of the SRD, BNI may consider collecting all related criteria, guidelines, and restrictions into a separate ad hoc standard in the appendices of the SRD which can be referenced as an SRD Safety Criterion Implementing Code and Standard and more easily used by field personnel.

There is reasonable assurance that the health and safety of the public, workers, and the environment will not be adversely affected by the approval of the ABARs. The approval complies with applicable laws, regulations, and River Protection Project Waste Treatment and Immobilization Plant (WTP) contractual requirements.

The proposed changes associated with the ABARs are effective immediately and shall be fully implemented within 30 days; i.e., the provisions of the amendment may be used immediately. Within 30 days, controlled copies of the SRD must be modified to reflect the proposed changes associated with these ABARs.

If you have any questions, please contact me, or your staff may call Lewis F. Miller, Jr., WTP Safety Authorization Basis Team, (509) 376-6817.

Sincerely,

for Roy J. Schepens
Manager

WTP:JST

Attachment

cc w/attach:
M. T. Sautman, DNFSB
J. M. Eller, PAC

Attachment
04-WTP-190

**Safety Evaluation Report (SER)
of Proposed Authorization Basis Amendment Requests (ABAR)
24590-WTP-SE-ENS-04-013, Revision 0 and
24590-WTP-SE-ENS-04-093, Revision 0
to the Safety Requirements Document (SRD)
for the River Protection Project Waste Treatment and Immobilization Plant (WTP)**

1.0 INTRODUCTION

The WTP authorization basis is the composite of information provided by Bechtel National, Inc. (the Contractor) in response to radiological, nuclear, and process safety requirements that is the basis on which the U.S. Department of Energy (DOE), Office of River Protection (ORP) grants permission to perform regulated activities. The authorization basis includes that information requested by the Contractor for inclusion in the authorization basis and subsequently accepted by the ORP. The authorization basis for the WTP includes the SRD. The SRD contains the approved set of radiological, nuclear and process safety standards and requirements, which if implemented, provide adequate protection for facility workers, the public, and the environment against hazards associated with the operation of the facility. By two letters dated June 3, 2004,[1&2] the Contractor submitted two proposed amendments to the SRD. This SER documents the ORP evaluation of the proposed changes in the ABARs.

2.0 BACKGROUND

The SRD contains a set of radiological, nuclear, and process safety standards necessary to ensure adequate protection of the health and safety of workers, co-located workers, the public, and the environment from radiological, nuclear, and process hazards. The SRD standards are developed by an iterative process. Included in the development process is continuing review of industry practices, particularly those references in the SRD, and review of the results of the process hazards and accident analyses as they evolve with the design of the facility for potential impacts on the SRD standards used to ensure protection for facility workers and the public.

ABAR 24590-WTP-SE-ENS-04-013, Revision 0, submitted to ORP by the Contractor proposed to: (1) tailor the SRD, Appendix C, Section 26.0, ASME B31.3 - 1996, to allow vacuum box leak testing of circumferential piping field welds inside an inaccessible area; (2) revise SRD, Appendix H, Section 6.0, to include vacuum box leak testing as a method of leak testing piping field welds in black cells; and (3) tailor the SRD, Appendix C, Section 26.0, ASME B31.3 - 1996, to require that if the 100% volumetric inspection using ultrasonic examination per ASME B31.3 paragraph 344.6, is conducted for welds to be vacuum box tested, then the ultrasonic examination shall be conducted using a method that creates and maintains a reproducible computerized image(s) of the entire weld in the axial and radial direction.

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[1] BNI letter from J. P. Henschel to R. J. Schepens, ORP, "Transmittal for Approval: Authorization Basis Amendment Request 24590-WTP-SE-ENS-04-013, Revision 0, Revise Leak Test Requirements for ASME B31.3 Piping in SRD," CCN: 090781, dated June 3, 2004.

[2] BNI letter from J. P. Henschel to R. J. Schepens, ORP, "Transmittal for Approval: Authorization Basis Amendment Request 24590-WTP-SE-ENS-04-093, Revision 0, Revise Leak Test Requirements for ASME B31.3 Piping Closure Welds in SRD," CCN: 090782, dated June 3, 2004.

ABAR 24590-WTP-SE-ENS-04-093, Revision 0, submitted to ORP by the Contractor proposed to: (1) tailor the SRD, Appendix C, Section 26.0, ASME B31.3 - 1996, to exclude closure welds (except those in black cells) from leak testing in accordance with paragraph 345.2.3 (c) of ASME B31.3 (c) - 1998 Addendum; and (2) revise SRD, Appendix H, to exclude closure welds in black cells from the provision of Subparagraph 345.2.3(c) of ASME B31.3 - 1998 that exempt closure welds from leak testing.

3.0 EVALUATION

3.1 Proposed Changes to SRD, Appendix C, Section 26.0, ASME B31.3 - 1996, Process Piping:

In summary, SRD safety criterions 4.4-3 and 5.1-2 require that process piping shall comply with ASME B31.3 - 1996 except as tailored for embedded ductwork and welded tees. The Contractor proposed to add additional tailoring to address utilization of vacuum box leak testing, in lieu of hydrostatic or pneumatic leak testing inside an inaccessible area and to exclude closure welds from leak testing (except in inaccessible areas [black cells]). Specifically, the proposed changes to Appendix C, Section 26.0 are presented below (changes are underlined):

WTP Specific Tailoring

The following tailoring of ASME B31.3, Process Piping, is required for use by the WTP contractor as an Implementing Standard for: (1) the fabrication and installation of those portions of the C5V ductwork that are being embedded in concrete; (2) the use of ASME B16.9 welding tees in accordance with ASME B31.3-2002; (3) the use of vacuum box leak testing; and (4) excluding closure weld criteria inside inaccessible areas.

1. The tailored paragraphs of ASME B31.3 applicable to vacuum box leak testing, in lieu of hydrostatic or pneumatic leak testing, will only be used to leak test full penetration circumferential piping butt field welds inside an inaccessible area (as defined in Appendix H, Section 6.0) out to the first isolation component outside the inaccessible area. Further, if the 100% volumetric inspection using ultrasonic examination per ASME B31.3 paragraph 344.6, is conducted for welds to be vacuum box tested, then the ultrasonic examination shall be conducted using a method that creates and maintains a reproducible computerized image(s) of the entire weld in the axial and radial direction.

2. The tailored paragraphs of ASME B31.3 adopting the provisions of ASME B31.3 (c) - 1998 Addendum paragraph 345.2.3 (c) are applicable to all ASME B31.3 piping in all facilities except for closure welds in inaccessible areas.

Important to Safety piping within the scope of SRD Safety Criterion 4.2-2 shall comply with ASME B31.3 - 1996, Process Piping, Chapter V, Paragraph 345, using the following approach. Vacuum box leak testing, in lieu of hydrostatic or pneumatic leak testing, may be used to leak test full penetration circumferential, piping, field butt welds inside an inaccessible area (as defined in Appendix H, Section 6.0) out to the first isolation component outside the inaccessible area, only under the following conditions:

- Vacuum Box Leak Test Method - The vacuum box leak test shall be in accordance with a Bubble Test - Vacuum Box Technique method specified in BPV Code, Section V, Article 10, Appendix II, with the following specific test requirements:

  (a) Sensitivity of the test shall be demonstrated to be not less than 1E-3 atm-ml/sec at 15 psig;

  (b) The test pressure shall be a partial vacuum of at least 7 psi below atmosphere, applied to the outside of the weld; and

  (c) The required partial vacuum shall be maintained for at least 20 sec examination time.

In addition, the following limitations and restrictions shall apply to the application of vacuum box leak testing in lieu of a hydrostatic or a pneumatic leak test:

- Vacuum box leak testing will only be used to leak test circumferential, piping, field welds inside an inaccessible area (as defined in Appendix H, Section 6.0). This includes any welds in extensions of piping systems contained or originating in inaccessible areas, between the inaccessible area boundary and the first isolation valve or device beyond the inaccessible area boundary;

- It shall only be used for piping field welds where required to avoid damage to components, ensure the safety to construction workers, perform leak tests of field welds where physical limitations prevent hydrostatic or pneumatic leak testing as prescribed in ASME B31.3 paragraph 345.4 and paragraph 345.5 respectively;

- Piping welds that are to be vacuum box leak tested will be assessed for suitability. The number of welds to be vacuum box leak tested shall be limited to two or three welds between termination points on a given pipe system-except where physical limitations prevent examination by hydrostatic or pneumatic leak testing. DOE will be informed of such exceptions, and may at its discretion and within 48 hours of being informed, respond to BNI on the suitability of the use of vacuum box leak testing for such instances. Termination points may be tanks, vessels, valves, etc. (Specifically excluded from the definition of termination points are junctions made with fittings to other piping systems and locations where the piping changes design class). This could be either the last two closure welds in an inaccessible area or the last closure weld in the inaccessible area and the last closure weld outside the inaccessible area. In addition, vacuum box leak testing would be permitted for the connection welds between construction modules if this is limited to one module-to-module weld per piping run within the cells. This is in addition

to termination welds on the piping run. A module is defined as a pre-leak-tested subassembly containing multiple pipe spools;

- Vacuum box leak testing shall be limited to full penetration girth butt welds, on straight pipe of the same nominal pipe size and same wall thickness on both sides of the weld at the weld location. Specifically excluded are straight pipe to piping component connection welds. Further, vacuum box leak testing shall be conducted with a vacuum box that completely encapsulates the piping, at the test location;

- All welds shall be 100% volumetrically inspected in accordance with ASME B31.3 - 1996, paragraphs 344.5 or 344.6. If the 100% volumetric inspection is conducted using ultrasonic examination per ASME B31.3 paragraph 344.6, then the ultrasonic examination shall be conducted using a method that creates and maintains a reproducible computerized image(s) of the entire weld in the axial and radial direction;

- It shall be limited to welds made using the Orbital welding machines. The only exception is that vacuum leak box testing may be used on manual welds if the 100% volumetric inspection was conducted by radiography per ASME B31.3 - 1996 paragraph 344.5;

- The piping systems and or components on both sides of the weld to be vacuum box leak tested shall have been subjected to a hydrostatic leak tested in accordance with ASME B31.3 - 1996 paragraph 345.4, a pneumatic leak test in accordance with ASME B31.3 - 1996 paragraph 345.5, a combination pneumatic-hydrostatic leak test in accordance with ASME B31.3 - 1996 paragraph 345.6, or in the case of components, leak tested in accordance with the Code or Standard applicable to the design of the component;

- At a minimum, a flexibility analysis in accordance with ASME B31.3 - 1996 paragraphs 319.4.2 (a) and (b) shall be required on any piping systems that contain welds that are to be vacuum leak box tested. In addition, a comprehensive flexibility analysis in accordance with ASME B31.3 - 1996 paragraphs 319.4.2 (c) and (d) shall be performed on any piping systems that contain welds that are to be vacuum box leak tested when the piping systems have a design temperature greater than or equal to 150 F;

- The requirements of ASME B31.3 paragraph 344.7.1 (a) through (g) shall be invoked on any weld to be vacuum box leak tested with the exception that the requirement of subparagraph 344.7.1 (e) "....aided by liquid penetrant or magnetic particle examination when specified in the engineering design." shall not be required. The implementation of these requirements shall be documented in the weld inspection report;

- Piping welds and the associated line numbers that are to be vacuum leak box tested shall be identified in advance of the testing. This identification shall be documented in the controlled document Weld List, which must include this information prior to the initiation of any vacuum box leak testing associated with those welds and line numbers. It is understood that the controlled document Weld List may need to be revised and updated periodically through the construction phase of the WTP Project; and

- The following special requirements shall be placed on the training programs used to certify the technicians that will be conducting the vacuum box leak tests:

  1. The BNI Construction Manager shall pre-approve the technician qualifying examination(s) for vacuum box leak testing;

  2. The BNI Construction Manager shall pre-approve the qualifications of each Level III technician preparing or giving the examinations for vacuum box leak testing;

  3. DOE ORP at their discretion shall reserve the right to observe any and/or all practical leak test examinations and review of the results of any and/or all written vacuum box leak test examinations;

  4. The minimum topical content of each Level II examination shall be specified by BNI, and approved by DOE;

  5. The 80% correct criteria for passing the examination shall apply to each part of the three part examinations that are to be given;

  6. BNI shall provide reasonable assurance that they will take adequate measures to assure the integrity of written examinations is maintained; and

  7. There shall be several versions of each examination in use to assure Level II knowledge and ability concerning vacuum box leak testing is confirmed.

Justification: The requirement for the vacuum box leak test sensitivity is consistent with the ASME B31.3 requirement for a sensitive leak test as given in ASME B31.3 paragraph 345.8 - 1996 and for at least 7 psi vacuum and an examination time of at least 20 seconds. The limitations in using vacuum box leak testing better define when this method can be used. DOE ORP may further change the definition and application of these special vacuum box leak testing criteria based on Contractor's experience with their use, or the Contractor's request for a change.

Evaluation (acceptable, as modified): Piping design, fabrication, installation, examination and testing at RPP-WTP is in accordance with the 1996 Edition of the ASME B31.3 Process Piping Code. This Code requires each piping system to be leak tested to ensure tightness prior to initial operation. The leak test shall be a hydrostatic test (1.5 x design pressure x scaling factor) or a pneumatic test (110% of design pressure) if the hydrostatic test is determined to be impracticable. If both a hydrostatic or pneumatic leak test is considered impracticable, provisions are made for using an alternative leak test. The alternative leak test is allowed only if two specific conditions are satisfied: (1) pneumatic testing would present an undue hazard due to stored energy release or brittle fracture; and (2) hydrostatic testing would damage linings or internal insulation, or contaminate a process, which would be hazardous, corrosive or inoperative in the presence of moisture or present a danger due to brittle fracture. The alternative leak test is required to be in accordance with ASME Section V Article 10 Gas and Bubble testing or another method of equal sensitivity. If the alternative

leak test is used, 100% volumetric examination is required for all circumferential, longitudinal, and spiral groove welds. All other welds including structural attachment welds require surface examination (MT or PT) and a piping flexibility analysis is required. The Code also makes provisions for leak testing piping and vessels together as a system, when the piping can not be isolated from the vessel. If the piping test pressure is the same or less than the vessel test pressure, the piping can be tested with the vessel.

Due to the number and orientation of vessel nozzles and piping in inaccessible areas, hydrostatic or pneumatic testing of field welds would be very difficult. The congestion in inaccessible area piping requires work sequencing that involves erection and removal of work platforms in carefully designed stages, thus severely limiting the access to completed welds for inspection purposes. Visual and volumetric examinations will be made prior to proceeding with installation of adjoining spool pieces. Once placed, adjoining spool pieces may eliminate access to previously made welds. No access inside the vessels is available thus eliminating the option of closing nozzles for testing. Hydrostatic testing would also require filling the vessels, most of which are several thousand gallons is size, multiple times with water for leak testing during construction. Additionally, the vessels in question are not designed for all of the potential process piping test pressures which set the testing parameters.

Due to the very congested black cells, unless workers were frequently evacuated to allow pneumatic testing, it would present an undue hazard to personnel and overpressurization of the vessels would still be required. Accordingly, both hydrostatic and pneumatic leak testing are deemed impractical for inaccessible area piping. The Contractor has proposed using vacuum box leak testing in inaccessible areas subject to the restrictions described above.

Considering the factors discussed above, the alternative approach described above is intended to address these issues, and enhance the constructability. The approach maintains the necessary level of safety and quality required by the SRD and the industry consensus codes and standards employed in construction.

The testing conducted by BNI on May 18, 2004, demonstrated that vacuum box leak testing could detect leaks in girth butt welds remote from structural discontinuities at a sensitivity level of at least 1E-3 atm-ml/sec. Further, this testing demonstrated that it could provide a sensitivity level consistent with the leak test sensitivity level in general employed by the ASME B31.3 Process Piping Code. Therefore, it is judged acceptable for use in lieu of a hydrostatic test or pneumatic test with the caveats and restrictions described above. These restrictions and caveats when applied in conjunction with the vacuum box leak testing approach provide a high degree of confidence that the piping systems in the inaccessible areas will be adequately leak tested, provided the narrow limitation on its use to tested configurations using personnel with well demonstrated qualifications are imposed.

3.2 Proposed Changes to SRD, Appendix H, Section 6.0, Inaccessible Areas:

In summary, SRD safety criterion Appendix H, Section 6.0, defines the concept of "black cells" as applied on the WTP and lists features included in "black cell" vessels and piping systems to achieve a comparable reliability with systems that are expected to last over 40 year design life without failure. Specifically, the proposed changes to Appendix H, Section 6.0 are underlined below:

- Leak Tests - Hydrostatic or pneumatic tests will be used to ensure that the vessels and process equipment are leak tight prior to startup. Hydrostatic, pneumatic, or vacuum box leak tests will be used to ensure that the piping is leak tight prior to startup except for piping system closure welds outside of inaccessible areas (as defined in SRD Appendix H, Section 6.0) that meet the requirements of ASME B31.3 - 1998, subparagraph 345.2.3(c). When ASME B31.3 - 1998 subparagraph 345.2.3(c) is invoked the following restrictions shall apply:

  1. It shall not be invoked on any closure welds on piping systems in inaccessible areas as defined in Section 6.0 of Appendix H of the SRD. This includes any welds in extensions of piping systems contained or originating in inaccessible areas, between the inaccessible area boundary and the first isolation valve, or device beyond the inaccessible area boundary;

  2. It shall only be invoked on full penetration butt welds in straight pipe, full penetration butt welds at the safe-end of an equipment nozzle, or full penetration butt welds the safe-end of branch connections. [The safe-end is defined as the piping to equipment nozzle connecting weld or the branch connection to branch piping connecting welds.];

  3. The requirements of ASME B31.3(c) - 1998, subparagraph 345.2.3 (c) shall be met;

  4. The piping systems and or components on both sides of the closure weld shall have been subjected to a hydrostatic leak tested in accordance with ASME B31.3 - 1996 paragraph 345.4, a pneumatic leak test in accordance with ASME B31.3 - 1996 paragraph 345.5, a combination pneumatic-hydrostatic leak test in accordance with ASME B31.3 - 1996 paragraph 345.6, or in the case of components leak tested in accordance with the Code or Standard applicable to the design of the component;

  5. The requirements of ASME B31.3 paragraph 344.7.1 (a) through (g) shall be invoked with the exception that the requirement of subparagraph 344.7.1 (e) "...aided by liquid penetrant or magnetic particle examination when specified in the engineering design." shall not be required. The implementation of these requirements shall be documented in the weld inspection report;

  6. Piping welds and the associated line numbers for which the closure weld classification is invoked shall be documented in a controlled document Weld List;

  7. Piping components may include mechanical elements other than piping; and

8. In addition, BNI shall incorporate these requirements into the appropriate specification (currently Specification 24590-WPT-3PS-PS02-T0003). DOE ORP may further change the definition and application on the use of closure welds based on Contractor's experience with their use or the Contractor's request for a change.

Evaluation (acceptable): Subparagraph 345.2.3(c) is a post 1996 addition to the ASME B31.3 Code that was added in the 1998 Addendum [B31.3(c)] that permits closure welds to not be leak tested provided other specified criteria are met. As such it is an approved Code approach. The limitations and restrictions described above insure it will be applied on a limited basis in areas that will be accessible during operation for repair. The piping in the black cells poses a unique situation in that no repairs or inspections are possible during the 40-year plant operational life. Therefore, DOE ORP approves this ABAR with the restriction that it cannot be used on piping in "Inaccessible Areas" as defined in Section 6.0 of Appendix H of the SRD.

4.0 CONCLUSION

On the basis of the Contractors proposals as amended, the ORP has concluded the proposed change does not create a new design basis event (DBE), increase in the consequence or frequency of the analyzed DBEs, and there is reasonable assurance that the health and safety of the public, the workers and the environment will not be adversely affected by the changes proposed by ABAR 24590-WTP-WE-ENS-04-013, Revision 0, and ABAR 24590-WTP-WE-ENS-04-093, Revision 0. The proposed changes continue to comply with applicable laws and regulations and conform to top-level standards. Accordingly, the proposed changes are acceptable as amended and the ORP approves the amendments as proposed in ABAR 24590-WTP-SE-ENS-04-013, Revision 0, and ABAR 24590-WTP-WE-ENS-04-093, Revision 0.